CLAIMS

WHAT IS CLAIMED:

1. An apparatus, comprising:

a substrate;

a first layer of waveguiding material above the substrate, the first layer having a first index of refraction, a first horizontal dimension, and a first vertical dimension; and

a second layer of waveguiding material adjacent the first layer, the second layer having a second index of refraction, a second horizontal dimension, and a second vertical dimension.

2. The apparatus of claim 1, wherein a selected electromagnetic mode propagates in a portion of the first layer approximately defined by at least one of the second horizontal dimension, the first vertical dimension, the first index of refraction, and the second index of refraction.

3. The apparatus of claim 2, wherein the selected electromagnetic mode is a selected polarization mode.

4. The apparatus of claim 3, wherein the selected polarization mode is a transverse electric mode.

5. The apparatus of claim 1, wherein the second vertical dimension is smaller than the first vertical dimension, the second horizontal dimension is smaller than the first horizontal dimension, and the second index of refraction is larger than the first index of refraction.

6. The apparatus of claim 5, wherein the second vertical dimension is approximately 350 angstroms.

7. The apparatus of claim 5, wherein the first index of refraction is approximately 1.5 and the second index of refraction is approximately 2.

8. The apparatus of claim 1, wherein the substrate is a CMOS chip substrate.

9. The apparatus of claim 1, further comprising an upper cladding layer above the second layer and at least a portion of the first layer.

10. The apparatus of claim 1, further comprising an active element above a portion of the second layer, the active element having a third index of refraction such that a portion of the selected electromagnetic mode propagates in the active element.

11. The apparatus of claim 10, wherein the active element comprises at least one of an electro-optically active element and a magneto-optically active element.

12. The apparatus of claim 10, further comprising a plurality of electrodes deployed proximate the active element and capable of providing an electric field to the active element.

13. An apparatus, comprising:

a substrate;

a first layer of waveguiding material above the substrate, the first layer having a first index of refraction;

a second layer of waveguiding material above the first layer, the second layer having a second index of refraction; and

an active element above a portion of the second layer, the active element having a third index of refraction selected such that a portion of the selected electromagnetic mode propagates in the active element.

14. The apparatus of claim 13, wherein the selected electromagnetic mode is a selected polarization mode.

15. The apparatus of claim 14, wherein the selected polarization mode is a transverse electric mode.

16. The apparatus of claim 13, wherein the first layer of waveguiding material has a first horizontal dimension and a first vertical dimension, wherein the second layer of waveguiding material has a second horizontal dimension and a second vertical dimension, and wherein the second vertical dimension is smaller than the first vertical dimension and the second horizontal dimension is smaller than the first horizontal dimension.

17. The apparatus of claim 16, wherein the second index of refraction is larger than the first index of refraction such that a selected electromagnetic mode propagates in a portion of the first layer approximately defined by the second horizontal dimension and the first vertical dimension.

18. The apparatus of claim 13, wherein the third index of refraction is intermediate the first and second indices of refraction.

19. The apparatus of claim 13, wherein the third index of refraction is larger than the first and second indices of refraction.

20. The apparatus of claim 13, wherein the active element comprises at least one of an electro-optically active element and a magneto-optically active element.

21. The apparatus of claim 13, wherein the third index of refraction is variable within a range of indices of refraction in response to an electric field applied to the active element.

22. The apparatus of claim 13, further comprising a plurality of electrodes deployed proximate the active element and capable of providing an electric field to the active element.

23. The apparatus of claim 13, wherein the active element has two ends, each end being tapered.

24. The apparatus of claim 13, further comprising an integrated circuit communicatively coupled to the first layer of waveguiding material.

25. The apparatus of claim 24, wherein the integrated circuit is communicatively coupled to at least one of the plurality of electrodes.

26. An method, comprising:

forming a first layer of waveguiding material above a substrate such that the first layer has a first index of refraction, a first horizontal dimension, and a first vertical dimension; and

forming a second layer of waveguiding material above the first layer such that the second layer has a second index of refraction, a second horizontal dimension, and a second vertical dimension.

27. The method of claim 26, wherein forming the second layer comprises forming the second layer such that a selected electromagnetic mode propagates in a portion of the first layer approximately defined by the second horizontal dimension and the first vertical dimension.

28. The method of claim 27, wherein forming the second layer comprises forming the second layer such that second vertical dimension is smaller than the first vertical dimension, the second horizontal dimension is smaller than the first horizontal dimension, and the second index of refraction is larger than the first index of refraction.

29. The method of claim 26, further comprising forming an upper cladding layer above the second layer and at least a portion of the first layer.

30. The method of claim 26, further comprising forming an active element above a portion of the second layer, the active element having a third index of refraction such that a portion of the selected electromagnetic mode propagates in the active element.

31. The method of claim 30, wherein forming the active element comprises forming at least one of an electro-optically active element and a magneto-optically active element.

32. The method of claim 30, further comprising forming a plurality of electrodes proximate the active element and capable of providing an electric field to the active element.

33. A method, comprising:

forming a first layer of waveguiding material above a substrate, the first layer having a first index of refraction, a first horizontal dimension, and a first vertical dimension;

forming a second layer of waveguiding material above the first layer, the second layer having a second index of refraction, a second horizontal dimension, and a second vertical dimension, the second vertical dimension being smaller than the first vertical dimension, the second horizontal dimension being smaller than the first horizontal dimension, and the second index of refraction being larger than the first index of refraction such that a selected electromagnetic mode propagates in a portion of the first layer approximately defined by the second horizontal dimension and the first vertical dimension; and

forming an active element above a portion of the second layer, the active element having a third index of refraction such that a portion of the selected electromagnetic mode propagates in the active element.

34. The method of claim 33, wherein forming the active element comprises forming the active elements having the third index of refraction that is intermediate the first and second indices of refraction.

35. The method of claim 33, wherein forming the active element comprises forming the active elements having the third index of refraction that is larger than the first and second indices of refraction.

36. The method of claim 33, wherein forming the active element comprises forming at least one of an electro-optically active element and a magneto-optically active element.

37. The method of claim 33, wherein forming the active element comprises forming the active elements having the third index of refraction that is variable within a range of indices of refraction in response to an electric field applied to the active element.

38. The method of claim 33, further comprising forming a plurality of electrodes proximate the active element and capable of providing an electric field to the active element.

39. A system for transforming optical wave modes, comprising:

an optical wave mode transformer optically coupled to a light source, the optical wave mode transformer comprising:

a first layer of waveguiding material above the substrate, the first layer having a first index of refraction, a first horizontal dimension, and a first vertical dimension; and

a second layer of waveguiding material above the first layer, the second layer having a second index of refraction, a second horizontal dimension, and a second vertical dimension; and

an optical element that is optically coupled to the optical wave mode transformer to receive the selected electromagnetic mode.

40. The system of claim 39, wherein at least one of the first index of refraction, the first horizontal dimension, the first vertical dimension, the second index of refraction, the second horizontal dimension, and the second vertical dimension are selected such that a selected

electromagnetic mode provided by the light source propagates in a portion of the first layer approximately defined by the second horizontal dimension and the first vertical dimension.

41. The system of claim 40, wherein the second vertical dimension is smaller than the first vertical dimension, the second horizontal dimension is smaller than the first horizontal dimension, and the second index of refraction is larger than the first index of refraction.

42. The system of claim 41, wherein the optical wave mode transformer further comprises:

an active element above a portion of the second layer, the active element having a third index of refraction such that a portion of the selected electromagnetic mode propagates in the active element; and

a plurality of electrodes deployed proximate the electro-optically active element and capable of providing an electric field to the electro-optically active element.

43. The system of claim 39, wherein the active element comprises at least one of an electro-optically active element and a magneto-optically active element.